Wound Healing and Defects Following Northern Hardwood Pruning

Darroll D. Skilling
Forester,
Lake States Forest Experiment Station,[1]
Forest Service,
U. S. Department of Agriculture

THE PRUNING of coniferous species to produce high quality lumber has become an accepted practice throughout many areas of the United States. The application of pruning to hardwood species, however, is still in the early stages of development. No general agreement exists among foresters concerning the advisability of such practices. A portion of this controversy arises out of the difference in thinking as to just what hardwood pruning is. Those thinking in terms of conifer pruning visualize pruning a certain number of trees per acre to a specified height. This type of pruning is probably not applicable to hardwoods. A more realistic approach to hardwood pruning would be the improvement of quality of a small number of trees per acre which, because of a few low branches, or early forking, would not at maturity yield high-quality timber products. With this approach, the pruning would more closely resemble a surgical operation—individual trees would be selected for pruning only when the removal of a few branches would materially increase the resulting tree grade.

With this approach to hardwood pruning in mind, a project was initiated during the fall of 1956 to determine the effect of individual pruning wounds on tree quality. This consisted of a dissection study of healed hardwood pruning wounds.

Information was developed on: (1) the effect of artificial pruning on the establishment of decay organisms through wounds, (2) the importance of pruning live versus dead branches in relation to decay development, (3) healing rates for pruning wounds of various sizes for different species, (4) the effect of artificial pruning on the development of lumber defects, and (5) the importance of epicormic branches which may develop after pruning.

[1]Maintained in cooperation with the University of Minnesota, St. Paul 1, Minn.

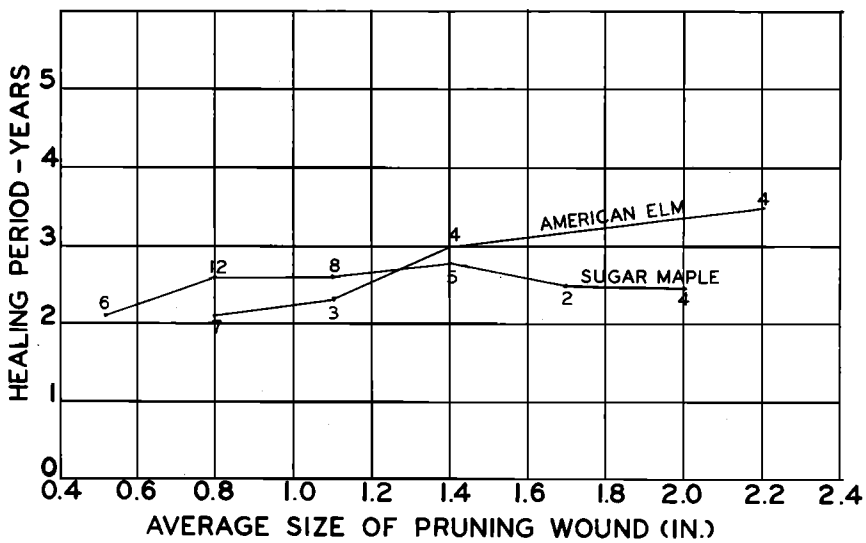

FIG. 1.—Period required for wounds of various sizes to heal (data combined by 0.3-inch classes).

Description of Pruning Treatment

The trees to be dissected were chosen from a large experiment established in 1938 by the personnel of the Nicolet National Forest and the Lake States Forest Experiment Station to determine the effects of thinning and pruning in young second-growth northern hardwoods.[2] In an 11-year-old stand growing on a good site, between 320 and 400 crop trees per acre were selected from the trees of good form, preferably in the dominant or codominant crown classes. These crop trees were pruned and then released by removing all trees within either 2½ or 5 feet of their bases. At the time of treatment, the stand averaged 2,810 trees per acre 0.6 inch and over in diameter; dominants averaged 2.0 inches in diameter and 21 feet in height. The stand was predominantly sugar maple (*Acer saccharum* Marsh.) and American elm (*Ulmus americana* L.). Minor species included white ash (*Fraxinus americana* L.), eastern hophornbeam (*Ostrya virginiana* [Mill.] K. Koch), American basswood (*Tilia americana* L.), and black cherry (*Prunus serotina* Ehrh.).

In the original experiment, all of the crop trees were pruned to assure a large sample of pruning wounds. In normal practice, only a small portion of these trees would have qualified for pruning. Pruning was done to half the total height of the trees by means of saws with extension handles.

In conjunction with this study a series of detailed measurements and photographs were taken on 263

[2]Stoeckeler, J. H., and C. F. Arbogast. Thinning and pruning in young second-growth hardwoods in northeastern Wisconsin. Soc. Amer. Foresters Proc. 1947: 328–346, illus. 1947.

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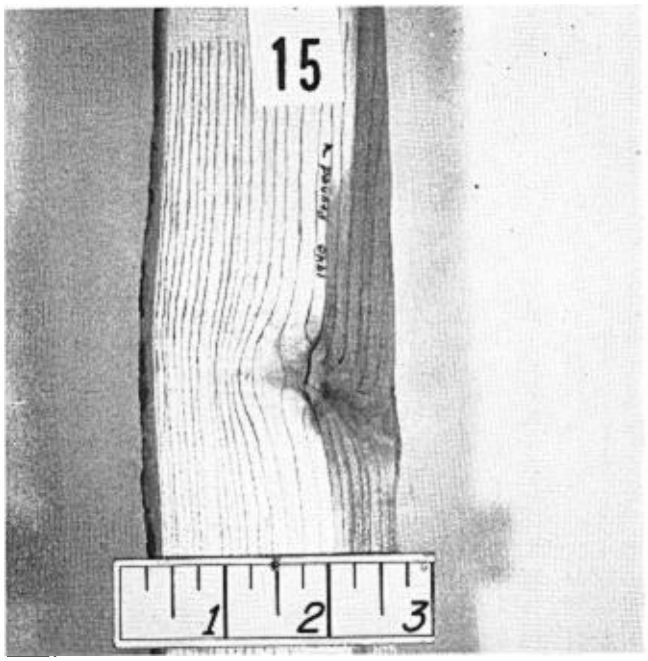

FIG. 2.—Artificial pruning of a live maple branch 0.5 inch in diameter. Note the rapid healing and resulting sound knot.

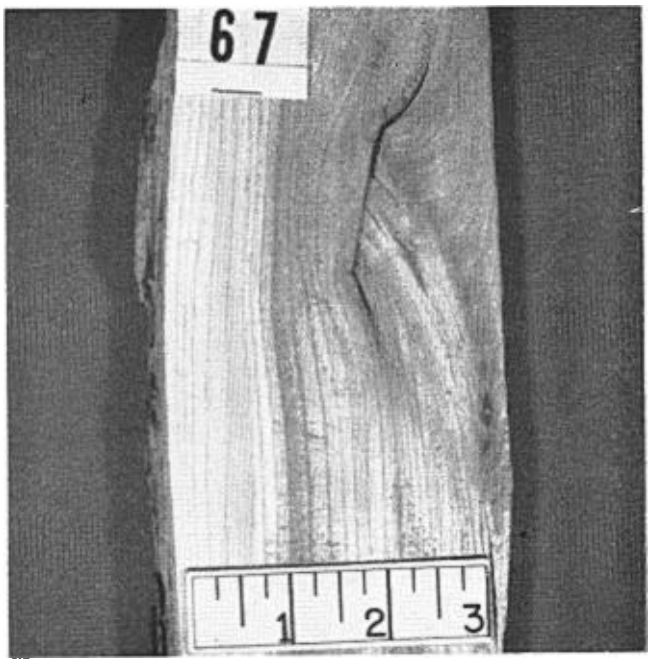

FIG. 3.—Artificial pruning in American elm. The live branch pruned in this instance was 1.8 inches in diameter. This wound was completely healed within 3 years.

pruning wounds from 118 trees. These data, taken over an 18-year period, provided the basis for the present study.

At the time of pruning, the following information was recorded: The diameter of limb, whether limb was dead or alive, size of wound after pruning, diameter of exposed heartwood, and presence or absence of incipient decay. Subsequent measurements were taken of healing rate and epicormic sprouting.

Selection of Sample Trees

Although several species of northern hardwoods were available, only sugar maple and American elm were selected for dissection. These two species showed indications of returning the largest amount of usable pruning information. Then, too, the study is a continuing one which would lose its value for the original purpose if too many trees were removed. A sample of 12 pruned and six unpruned trees of each species was cut. They had 114 pruning wounds. The present study depended more on the number and character of the wounds than on the number of trees. Therefore, in the selection of sample trees, an attempt was made to include sufficient wounds of each size and branch condition to indicate any significant differences. The unpruned sample trees were selected to correspond as nearly as possible to the pruned trees in both crown class and stem diameter.

In addition, 38 sugar maple and 18 American elm trees were selected at random to study the importance of any epicormic branches that had developed after pruning; these trees, of course, were not dissected.

Dissection of Pruning Wounds

After selection of the sample trees the individual pruning wounds were labeled so their identity could be retained throughout the dissection process. During September of 1956, the sample trees were cut and a 12-inch section of the bole surrounding each wound was removed. Photographs were then taken of the exterior characteristics of each wound. A radial cut was made through the center of each branch scar, exposing a side view of the wound healing process. Photographs were again made showing an interior view. This provided a complete photographic record of each wound from the time of pruning to the final dissection. Information was then obtained on the following wound healing characteristics: rate of healing, production of clear wood after healing, establishment of decay organisms, and formation of epicormic branches.

Results

The data showed no significant difference between the amount of decay present in wounds resulting from dead branch pruning and those from pruning live branches. Although several of the dead branches were more or less decayed at the time of pruning, this was sap-rot caused by secondary fungi and limited to the exposed wood in the wound. The decay did not advance into the adjacent parts of the stem as would be true if heart-rot fungi had become established before the pruned stub was occluded. This agrees closely with data presented by Roth[3] for white and black oak in Connecticut.

The effect of branch condition at the time of pruning on wound healing rates was rather minor. Live branch scars healed slightly faster than those from dead branches. The difference, however, was too

[3]Roth, E. R. The effect of pruning on the heart rot hazard in hardwoods. U. S. Bur. Plant Indus., 10 pp. (Processed.) 1939.

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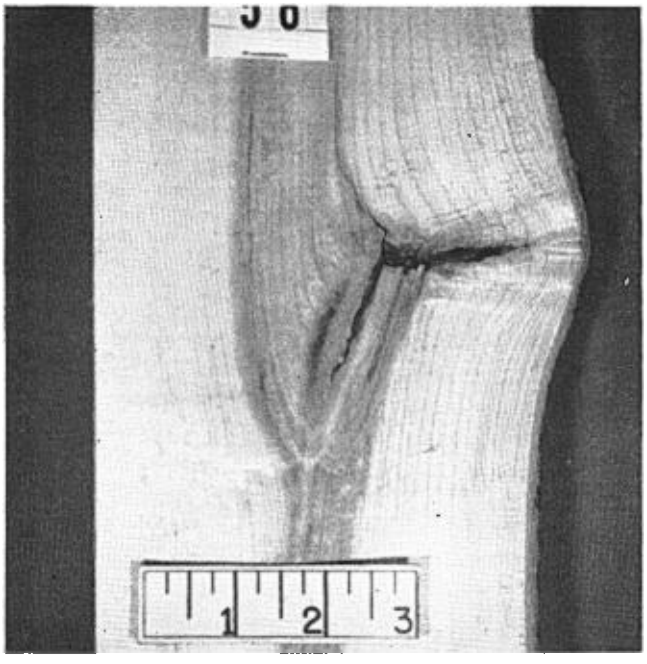

FIG. 4.—Natural pruning in sugar maple. Overgrown bark and a decay pocket have developed during healing. Defects of this type are frequently associated with branches protruding at an acute angle from the main stem. Although the decay in this branch was not a true heart rotter and was arrested after the wound healed, it did result in an unsound knot.

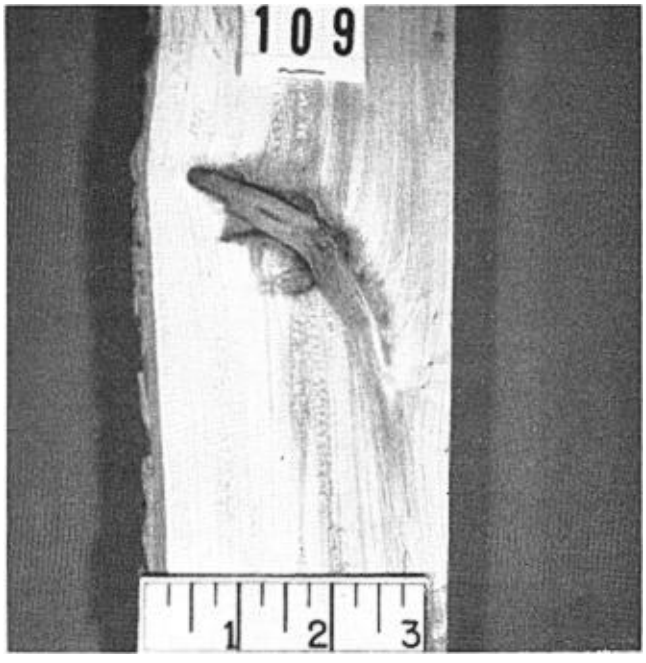

FIG. 5.—Natural pruning in American elm. A period of 14 years elapsed between the death of the branch and final wound healing. These dead branch stubs are eventually overgrown, but not until several years' growth of future lumber has been degraded.

small to be of practical significance. No relationship was found between artificial pruning of sugar maple and the development of stain adjacent to the wound area.

To determine whether wound healing rates were influenced by species and wound size, comparisons were made between elm and maple wounds of various sizes. As can be seen from Figure 1, healing rates on wounds up to 2 inches in diameter were practically constant regardless of species or wound size. Healing rates were strongly influenced, however, by tree growth rates and length of branch stub remaining after pruning. On those trees where the pruned branch stub extended ¼ inch beyond the bark, the period necessary for wound healing was increased by 1 to 3 years. The rapid healing of properly pruned branches is il-

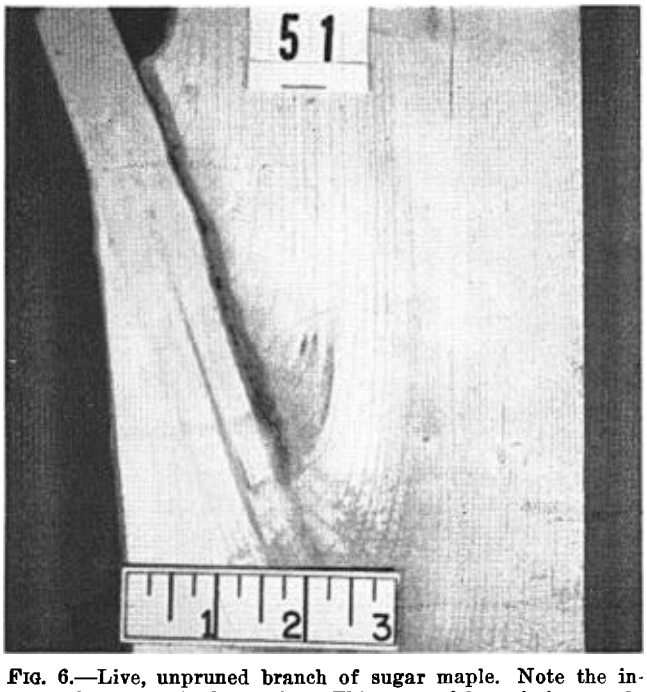

FIG. 6.—Live, unpruned branch of sugar maple. Note the ingrown bark that is developing. This type of branch frequently results in a weak crotch which eventually splits open.

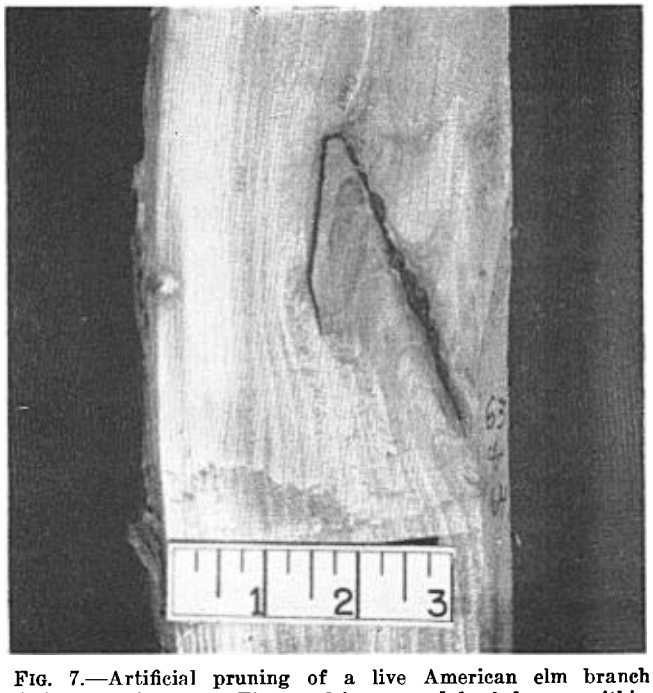

FIG. 7.—Artificial pruning of a live American elm branch similar to Figure 4. The resulting wound healed over within 2 years.

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lustrated in Figures 2 and 3.

Tests were made to determine the effect of artificial pruning on the development of lumber defects. Tree sections from both natural and artificially pruned branches were compared. Naturally pruned branches showed a high proportion of typical lumber defects. The most important of these were relatively long, unsound branch stubs, overgrown bark, and local decay pockets. Some examples of these defects are shown in Figures 4, 5, and 6. In all dissections of artificial pruning wounds, however, little or no defects of these types had developed after pruning (Fig. 7). No heart-rot fungi were found in any of the artificially pruned branches. The branch scars had healed over in every case, providing only sound knots.

An analysis was made on 38 pruned sugar maple and 18 pruned American elm to determine the importance of epicormic branches which may develop after pruning. The results of this analysis show that in the dominant and codominant crown classes epicormic branching is a minor factor and for all practical purposes can be disregarded (Table 1). However, epicormic branching on suppressed and intermediate trees was very serious. On these trees, the effect of pruning has essentially been lost.

TABLE 1.—THE DEVELOPMENT OF EPICORMIC BRANCHES FOLLOWING ARTIFICIAL PRUNING OF SUGAR MAPLE AND AMERICAN ELM

Crown class 1956	Trees pruned 1938	Pruning wounds	Trees with epicormic branches 1956	Wounds with epicormic branches 1956	Total living epicormic branches 1956	Wounds with epicormic branches
	Number	*Number*	*Number*	*Number*	*Number*	*Percent*
			SUGAR MAPLE			
Dominant	6	10	1	1	1	10
Codominant	14	38	1	1	1	3
Intermediate	6	19	2	4	12	21
Suppressed	12	28	12	15	55	54
			AMERICAN ELM			
Dominant	14	36	0	0	0	0
Codominant	3	4	0	0	0	0
Intermediate	--	--	--	--	--	--
Suppressed	1	3	1	1	5	331

Conclusions and Summary

The results of this investigation indicate that artificial pruning in young northern hardwood stands has possible practical applications. Live branch pruning, rather than promoting decay as indicated by Mayer-Wegelin,[4] has resulted in rapid healing of all wounds under 2 inches in diameter. The importance of species and branch size on wound healing rates was not evident as long as the branch scars were under 2 inches. Healing rates of wounds larger than 2 inches would probably be influenced to some extent by wound size.

The necessity of pruning branches close to the bole was brought out emphatically during this study. Retention of even a ¼-inch branch stub resulted in a delay in wound healing of 1 to 3 years.

Lumber defects such as decay pockets, overgrown bark, and long unsound branch stubs were found in a high percentage of natural pruning wounds. Artificially pruned branches, however, developed none of these defects following pruning. In all cases the wounds had healed over, producing sound, tight knots, free of heart rot. In no instance was there any indication that artificial pruning encouraged the development of decay.

A careful study was made of epicormic branching which may develop after pruning. The profuse development of these sprouts could eliminate any beneficial effects of artificial pruning. On the study area, epicormic branching was not serious as long as pruning was confined to dominant and codominant trees. In many cases, however, the effect of pruning trees in the lower crown classes has been nullified by subsequent branching.

[4]Mayer-Wegelin, H. Astung (Pruning). Schaper, Hanover, Germany; U. S. Forest Serv. Translation No. 264 (trans. by C. P. de Blumenthal). 1936.

Maynard H. McCormick (1911-1957)

Maynard H. McCormick, 46, was killed in an automobile accident November 17, 1957. Mr. McCormick, who had been with the Bureau of Land Management for 17 years, was enroute to a new assignment in Coos Bay, Ore. at the time of the accident. He was being transferred from the Roseburg Forest District.

Mr. McCormick was born in Grand Lodge, Mich. August 5, 1911 and graduated from Oregon State College with a B.S. degree in forestry in 1940.

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